

[0062] Use of ordinal terms such as “first,” “second,” “third,” etc., in the claims to modify a claim element does not by itself connote any priority, precedence, or order of one claim element over another or the temporal order in which acts of a method are performed, but are used merely as labels to distinguish one claim element having a certain name from another element having a same name (but for use of the ordinal term) to distinguish the claim elements.

[0063] Also, the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having,” “containing,” “involving,” and variations thereof herein, is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

What is claimed is:

1. A foreign object detection method for a wireless power transmitter having a matching network and transmit coil, the method comprising:

- (A) energizing the matching network and transmit coil and exciting resonance between the matching network and transmit coil;
- (B) allowing the resonance to decay;
- (C) measuring a temporal characteristic of the decay; and
- (D) analyzing the temporal characteristic to determine whether a foreign object is coupled to an electromagnetic field generated by the transmit coil.

2. The foreign object detection method of claim 1, wherein (A) comprises switching an inverter of the wireless power transmitter.

3. The foreign object detection method of claim 2, wherein (A) transfers sufficient energy to a wireless power receiver to charge a rectifier filter capacitor of a wireless power receiver to a level sufficient to reverse bias rectifier diodes of a wireless power receiver prior to (B).

4. The foreign object detection method of claim 2, wherein (A) comprises switching the inverter for a first period of time and a second period of time after the first period of time, wherein the inverter transfers a lower energy level in the second period of time than in the first period of time.

5. The foreign object detection method of claim 4, wherein a power supply voltage of the inverter is lower in the second period of time than in the first period of time.

6. The foreign object detection method of claim 4, wherein the inverter has a first switching frequency during the first period of time and a second switching frequency during the second period of time, the first and second switching frequencies being different.

7. The foreign object detection method of claim 6, wherein the resonance has a resonant frequency, and the first switching frequency is closer than the second switching frequency to the resonant frequency.

8. The foreign object detection method of claim 7, wherein (A) transfers sufficient energy to a wireless power receiver to charge a rectifier filter capacitor of the wireless power receiver to a level sufficient to reverse bias rectifier diodes of the wireless power receiver prior to (B).

9. The foreign object detection method of claim 1, wherein (B) is performed without energy input to the matching network or transmit coil.

10. The foreign object detection method of claim 9, wherein (A) comprises switching an inverter of the wireless

power transmitter and (B) comprises stopping the switching of the inverter and holding its output in a low impedance state.

11. The foreign object detection method of claim 1, wherein (C) is performed using continuous time measurements or discrete time measurements.

12. The foreign object detection method of claim 1, wherein (D) comprises determining a quality factor.

13. The foreign object detection method of claim 12, wherein (D) comprises comparing the quality factor to an acceptable quality factor for wireless power transmission.

14. The foreign object detection method of claim 13, wherein the acceptable quality factor is at least in part derived from a quality factor value provided to the wireless power transmitter by a wireless power receiver via in-band or out-of-band communication.

15. The foreign object detection method of claim 1, further comprising:

- (E) determining whether to allow or inhibit wireless power transfer based on (D).

16. At least one non-transitory computer readable storage medium having stored thereon instructions, which, when executed by a processor, perform a foreign object detection method for a wireless power transmitter having a matching network and transmit coil, the method comprising:

- (A) energizing the matching network and transmit coil and exciting resonance between the matching network and transmit coil;
- (B) allowing the resonance to decay;
- (C) measuring a temporal characteristic of the decay; and
- (D) analyzing the temporal characteristic to determine whether a foreign object is coupled to an electromagnetic field generated by the transmit coil.

17. An apparatus for performing foreign object detection for a wireless power transmitter having a matching network and transmit coil, the apparatus comprising:

circuitry configured to:

- (A) energize the matching network and transmit coil and excite resonance between the matching network and transmit coil;
- (B) allow the resonance to decay;
- (C) measure a temporal characteristic of the decay; and
- (D) analyze the temporal characteristic to determine whether a foreign object is coupled to an electromagnetic field generated by the transmit coil.

18. An apparatus for driving a wireless power transmitter and performing foreign object detection, the apparatus comprising:

- a drive circuit configured to energize a matching network and transmit coil of the wireless power transmitter, excite resonance between the matching network and transmit coil, and allow the resonance to decay; and
- a controller configured to control the drive circuit, measure a temporal characteristic of the decay and analyze the temporal characteristic to determine whether a foreign object is coupled to an electromagnetic field generated by the transmit coil.

19. The apparatus of claim 18, wherein the drive circuit comprises an inverter configured to energize and excite the resonance by switching in response to a control signal produced using the controller.

20. The apparatus of claim 19, wherein the inverter is switched for a first period of time and a second period of time after the first period of time to energize and excite